ON THE LARVA AND SPAT OF THE CANADIAN OYSTER.

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UPON opening the Marine Biological Station of Canada for last summer's work the acting director, Professor Ramsay Wright, assigned to me the diagnosis of bivalve-larvæ occurring in the plankton.

The material was collected over the oyster-beds near Curtain Island, off Malpeque, P. E. I. Oyster-larvæ were first recognized on the 25th of July from which time they were present in the plankton collections until the 1st of Sept.

The free-swimming, pelagic larva of the oyster possesses a characteristic color, brownish-red — suggestive of the soil of its native island shores, a shade which enables it to be immediately distinguished from every other bivalve-larva with which it is associated. The shell is asymmetrical and inequivalve, the left valve being larger, more convex, and with a large umbo, the right smaller, flatter and with a moderate umbo. The umbos have a postero-dorsal position and project backwards and upwards, making the shell broader, deeper and squarer behind and tapering but rounded in front. The largest measure .358 × .365 mm. in length and height, but the height and shape vary according to whichever side is turned towards the observer. Larvæ as small as .131 × .138 mm. already possess the characteristic shape and color.

The internal structure of the larval oyster offers some interesting features. We have been accustomed to think of it as vastly different from other bivalve-larvæ, corresponding to the early assumption of a sessile mode of life. This misconception is due to lack of observation of plankton stages, embryologists having jumped from early veliger or phylembryo to late prodissoconch or even early nepionic periods.

When mounted on a slide the larvæ are accustomed to remain

quiescent and from their deep coloration are difficult to examine but sometimes a more transparent one permits certain organs to be traced. When freshly collected and examined in a watch-glass of pure sea-water many of them exhibit the greatest activity, protruding the velum between the antero-ventral margins of the shell, expanding it somewhat like opening an umbrella, and swimming rapidly about by the violent movement of its cilia. While in motion the heavy shell is suspended below the expanded velum. Jarring the watch-glass will cause the animal to instantly withdraw its velum, at the same time snapping the valves of its shell together and dropping towards the bottom. Upon again assuming activity it may protude a long, slim, ciliated foot from the middle of its ventral surface, just behind the velum. The foot at this period is well developed and is a most capable organ by means of which the animal can creep rapidly about and forcibly flop its heavy shell from one side to the other. It can also bend up along the outside of the shell and perform feeling movements over all parts of the body within the shell. Its lower or posterior surface sometimes appears flattened or even grooved lengthwise and at a short distance from the base of attachment to the body there is a heel-like projection which is doubtless the position of the byssus gland. In the proximal part of the foot, *i. e.*, about the center of the animal, are right and left otocysts each containing about a dozen otoconia. A little before and above these, but more superficial, are two lateral, black pigment-spots (eye-spots). Along each side, past the base of attachment of the foot to the body, lies a series of short gill-filaments, extending from the eye-spot backwards and downwards to near the posterior margin of the shell; in the oldest free-swimming larvæ there are eight, diminishing in size from before backwards, the last ones being mere knobs; their lower ends are free, but their upper ends spring from one continuous axis of origin, that, behind the foot, joins its mate of the opposite side near the margins of the mantle. The mouth and œsophagus lie in the median plane immediately below and behind the velum to which they are attached and with which they are protruded and withdrawn. In the quiescent animal the gullet lies between velum and foot, in the median sagittal plane as well

as in, or very near, the median transverse plane of the body. Here it passes dorsalwards, between the first gill-filaments, expanding into the stomach with its large lateral liver-sacs. The intestine passes backwards towards the right, and then forwards towards the left, when it again turns backwards and upwards in the left umbo, and finally downwards in the median plane, over the posterior adductor muscle ; the greater part of its folds lie in the larger, left valve. In front and above the velum is a transverse adductor muscle, while below the posterior parts of the umbos is a larger, transverse, posterior adductor muscle ; retractor fibers converge from the velum to points in the umbos. Right and left mantle-folds line the inner surfaces of the valves.

Examination of eel-grass, rock-weed and other marine plants, of shells, stones, sand and other objects, revealed no young spat. Bundles of brush were tied to submerged rocks, or weighted with stones and sunk at various places. These were carefully examined at intervals but without result. Window-glass was cut into strips 2 × 6 in. and stood on end in crocks, about a dozen in each held apart by wire racks, the crocks being then set out below low-water level on oyster beds and made secure by building stones around them. Daily examination of the glass was made until, on the 16th Aug., I found my first young oyster-spat. It measured 1.030 × .876 mm. in length and depth and exhibited the characteristic coloration of the pelagic larva. In the centre of its dorsal surface could be distinctly recognized the shell (prodissoconch) of the oldest free-swimming stage (.384 × .369 mm.), securely fixed to the glass by its left valve. The anterior adductor appeared to be moved slightly backwards and upwards from its original position, and the posterior adductor had moved downwards and backwards to a position outside the border of the prodissoconch. Behind it opened the rectum. In front of the adductors and in a direction parallel with them, slanting downwards and backwards, were the axes of two sets of gill-filaments, the deeper (left) of sixteen long filaments with their free ends pointing forwards or forwards and downwards, the upper (right) of about half that number of short filaments that ceased below the posterior adductor muscle. No foot could be recognized. The new spat shell was very thin and

delicate, its prisms easily separating from each other at the margins, while beyond these at places the mantle was sometimes protruded.

Three other spat oysters were procured on glass in the same way, the dates and sizes being: Aug. 19, 1.20 × 1.58 mm.; Aug. 22, .55 × .51 mm.; Aug. 31, .953 × .861 mm.

Search was made daily for spat on natural marine objects and on Sept. 2nd I found the first, on the outer surface of a half-grown oyster shell. It measured 2.3 × 2.4 mm., but instead of having a pink, red, or brown coloration as one would suspect from comparison with the larval or earliest spat stages; or, instead of having a chalky-white appearance as one would judge from comparison with the old oysters; it presented a shining, dark metallic lustre with a few faint radial lines. From this time onwards they were to be found in increasing numbers, and, after being once shown them, the deck hands of the government steamer Ostrea could also find them. Altogether I have observed spat oysters on the shells of the oyster, mussel, clam, quohog, bar-clam, razor-clam, round whelk, and on stones. The objects with which they may be most easily conflicted are the young of *Crepidula fornicata* and colonies of *Ralfsia verrucosa*. At the time of leaving Malpeque, Sept. 20, the largest this year's spat I had seen measured 6 mm. in height, had a dark steel lustre, radiating ridges or lines, and very thin edges; the whole oyster being thin and fitting so solidly against the supporting shell as to require some force with a knife-blade to separate it.

As to the rate of growth my 4th spat oyster on glass was obtained Aug. 31, when it measured .953 × .861 mm. and had about sixteen gill-filaments. On Sept. 7 it measured 1.261 × 1.276 mm. and had about twenty-four gill filaments. A week later it measured 1.661 × 1.753 mm. One might say that it doubled its length and height in two weeks. The smallest oysters were about the size of one's thumb nail. I have put out wire baskets containing numbers of selected, half-grown, living oysters, having black spat attached, to be examined next spring.

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